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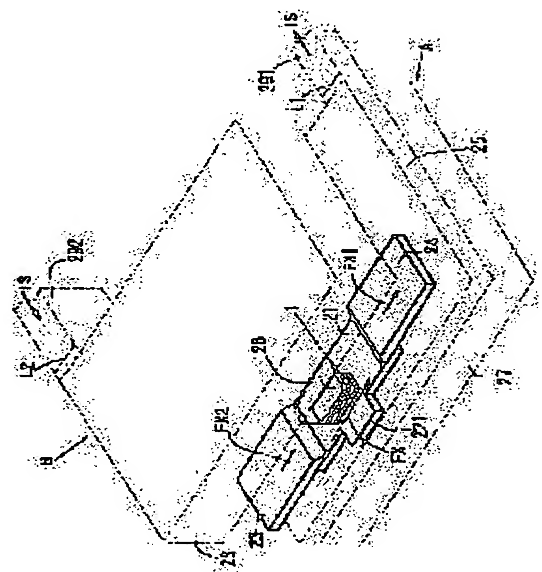
(54) TUNNEL MAGNETO-RESISTANCE EFFECT ELEMENT, THIN FILM MAGNETIC HEAD, MAGNETIC HEAD DEVICE AND MAGNETIC DISK DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a TMR element capable of strengthening a bias magnetic field impressed to a free layer.
SOLUTION: A ferromagnetic tunnel effect layer 1 has a structure where a tunnel barrier layer 11 is horded by a free layer 12 and a pinned layer 14. Magnetic bias means 21, 23 and 24 apply a bias magnetic field FX to the free layer 12. At least one of first and second conductive layers A and B generates magnetic field components FX1 and FX2 in the same direction as that for the bias magnetic field FX by a sense current IS flowing in itself.



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CLAIMS

[Claim(s)]
[Claim 1] It is a tunnel magneto-resistive effect component containing the ferromagnetic tunnel effect film, a magnetic-bias means, the 1st conductive layer, and the 2nd conductive layer. Said ferromagnetic tunnel effect film It has the structure whose tunnel barrier layer was pinched by the free layer and the pinned layer. Said magnetic-bias means It is what impresses a bias field to said free layer. Said 1st conductive layer It is arranged at the whole surface side of said ferromagnetic tunnel effect film, and flows electrically on said ferromagnetic tunnel effect film. Said 2nd conductive layer On the other hand, it is arranged at a side, and flows electrically on said ferromagnetic tunnel effect film. said ferromagnetic tunnel effect film — either [at least] said 1st conductive layer or the 2nd conductive layer The tunnel magneto-resistive effect component which produces the field component of the same direction as said bias field according to the sense current which flows to self.
[Claim 2] It is the tunnel magneto-resistive effect component indicated by claim 1. Said 1st conductive layer The 1st electrode / magnetic-shielding section, and the 1st lead polar zone are included. Said the 1st electrode / magnetic-shielding section It is arranged at the whole surface side of said ferromagnetic tunnel effect film. Said 1st lead polar zone The tunnel magneto-resistive effect component with which the sense current which flows in said the 1st electrode / magnetic-shielding section follows electrically a part of said the 1st electrode / magnetic-shielding section in the location which produces the field component of the same direction as said bias field.
[Claim 3] It is the tunnel magneto-resistive effect component which continues electrically at a part of said the 1st electrode / magnetic-shielding section in the location which is the tunnel magneto-resistive effect component indicated by claim 2, and was separated from the center line of said ferromagnetic tunnel effect film with which the direction of said bias field and said 1st lead polar zone cross at right angles in the direction of said bias field.
[Claim 4] It is the tunnel magneto-resistive effect component indicated by any of claims 2 or 3 they are. Said 2nd conductive layer The 2nd electrode / magnetic-shielding section, and the 2nd lead polar zone are included. Said the 2nd electrode / magnetic-shielding section On the other hand, it is arranged at the side. said ferromagnetic tunnel effect film — said 2nd lead polar zone The tunnel magneto-resistive effect component with which the sense current which flows in said the 2nd electrode / magnetic-shielding section follows electrically a part of said the 2nd electrode / magnetic-shielding section in the location which produces the field component of the same direction as said bias field.
[Claim 5] It is the tunnel magneto-resistive effect component which continues electrically at a part of said the 2nd electrode / magnetic-shielding section in the location which is the tunnel magneto-resistive effect component indicated by claim 4, and was separated from the center line of said ferromagnetic tunnel effect film with which the direction of said bias field and said 2nd lead polar zone cross at right angles in the direction of said bias field.
[Claim 6] It is the tunnel magneto-resistive effect component which is a tunnel magneto-resistive effect component indicated by any of claims 4 or 5 they are, divides said 1st lead polar zone and said 2nd lead polar zone into the both sides of said center line, and is arranged.
[Claim 7] It is the tunnel magneto-resistive effect component to which it is the tunnel magneto-resistive effect component indicated by any of claims 4 or 5 they are, and said 1st lead polar zone and said 2nd lead polar zone are located in one side of said center line.
[Claim 8] It is the tunnel magneto-resistive effect component indicated by any of claims 6 or 7 they are. The 1st central point set up as the middle point of boundary length on the boundary line produced between said the 1st electrode / magnetic-shielding section, and said 1st lead polar zone, Or the 2nd central point set up as the middle point of boundary length on the boundary line produced between said the 2nd electrode / magnetic-shielding section, and said 2nd lead polar zone, The tunnel magneto-resistive effect component whose plane angle which the segment which connects the central point set as said ferromagnetic tunnel effect film makes to the segment lengthened in the direction of said bias field is 5 degrees or more.
[Claim 9] that to which it is the tunnel magneto-resistive effect component indicated by any [claim 1 thru/or] of 8 they are, as for said bias grant means, said magnetic-bias means impresses a bias field to said bias field induction layer including a bias grant means and a bias field induction layer, and said bias field induction layer impresses a bias field to said free layer — it is — such — a ** tunnel magneto-resistive effect component.
[Claim 10] For said bias field induction layer, an end is the tunnel magneto-resistive effect component for which it is the tunnel magneto-resistive effect component indicated by any [claim 1 thru/or] of 9 they are, and said flux guide section constituted the flux probe section, and has projected it including the flux guide section by width of face with said flux probe section narrower than full [of said magnetic-bias means].

[Claim 11] It is the tunnel magneto-resistive effect component indicated by any [claim 1 thru/or] of 9 they are. Said magnetic-bias means A bias grant means, a bias field induction layer, and a flux guide layer are included. Said bias grant means It is what impresses a bias field to said bias field induction layer. Said bias field induction layer It is what impresses a bias field to said free layer. Said flux guide layer As the direction of the bias field of said bias field induction layer is intersected, while a laminating is carried out to said bias field induction layer It is the tunnel magneto-resistive effect component which it was magnetically combined with said free layer, and the end constituted the flux probe section, and the width of face of said flux probe section is narrower than the width of face of said bias field induction layer, and has been projected from said bias field induction layer.
[Claim 12] It is the thin film magnetic head which it is the thin film magnetic head containing at least one read-out component, and said read-out component becomes with the tunnel magneto-resistive effect component indicated by any [claim 1 thru/or] of 10 they are.
[Claim 13] The thin film magnetic head which is the thin film magnetic head indicated by claim 12, and contains at least one write-in component further.
[Claim 14] the thin film magnetic head indicated by claim 13 -- it is -- said write-in component -- an induction type -- electromagnetism -- a sensing element -- it is -- said induction type -- electromagnetism -- the thin film magnetic head from which the sensing element contains the 1st magnetic film, 2nd magnetic film, and gap film, each end is separated with said gap film, and said the 1st magnetic film and said 2nd magnetic film constitute the write-in pole section.
[Claim 15] the thin film magnetic head indicated by claim 13 -- it is -- said write-in component -- an induction type -- electromagnetism -- a sensing element -- it is -- said induction type -- electromagnetism -- the thin film magnetic head with which said 1st magnetic film contains the main pole and an auxiliary magnetic pole including the 1st magnetic film and the 2nd magnetic film in the sensing element, said main pole constitutes the perpendicular write-in pole section, and said auxiliary magnetic pole has combined magnetically said main pole and said 1st magnetic film.
[Claim 16] It is magnetic-head equipment with which are magnetic-head equipment containing the thin film magnetic head and head means for supporting, and said thin film magnetic head was indicated by any [claim 12 thru/or] of 15 they are, and said head means for supporting come to support said thin film magnetic head.
[Claim 17] It is the magnetic disk drive with which are a magnetic disk drive containing magnetic-head equipment and a magnetic disk, and said magnetic-head equipment was indicated by claim 16, and said magnetic disk comes to carry out magnetic recording and playback between said magnetic-head equipment.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a tunnel magneto-resistive effect component (a TMR component is called below), the thin film magnetic head, magnetic-head equipment, and a magnetic disk drive.
[0002]
[Description of the Prior Art] The head of high sensitivity and high power is demanded in connection with the densification of a hard disk (HDD). The TMR component attracts attention as what meets this demand. The TMR component uses the ferromagnetic tunnel effect film which consists of multilayer structure of a ferromagnetic layer / tunnel barrier layer / ferromagnetic layer. The ferromagnetic tunnel effect means the phenomenon in which the tunnel current which flows a tunnel barrier layer changes depending on whenever [angular relation / of magnetization of both ferromagnetic layers], when passing a current between the ferromagnetic layers of the pair whose tunnel barrier layer is pinched. The tunnel barrier layer in this case is a thin insulator layer, and it can pass an electron, saving spin according to the tunnel effect.
[0003] In the TMR component, it is reported that 12% or more of resistance rate-of-change **R/R is shown. about [from which application of magnetic HEDDOHE still began although such a TMR component was expected as a next-generation sensor which replaces the sensor which used the spin bulb film (the Spin Valve film and the following SV film are called)] -- it is -- as one of the present technical problems -- a TMR property -- the maximum student or **** -- development of new head structure is mentioned. That is, in order for the ferromagnetic tunnel effect film itself to take the geometric structure of passing a current in the thickness direction of a cascade screen, the design of new head structure by which the conventional proposal is not made is required.
[0004] The conventional example which applied the TMR component to magnetic-head structure is indicated by U.S.P.5,729,410, U.S.P.5,898,547, U.S.P.5,898,548, U.S.P.5,901,018, etc. In these official reports, the technical improvement is proposed that it can respond mainly to super-high density record. However, the development demand of the TMR magnetic head to super-high density record will become more advanced, and it waits eagerly for the proposal of the highly efficient TMR magnetic head also compared with the former.
[0005] For example, it is very important how when using a TMR component as a reading component of the thin film magnetic head, a means to impress a bias field to a free layer is constituted, in order to secure operational stability. Since a current flows to a film surface perpendicular in the case of a TMR component, if a hard magnet is contacted at the component edge like a GMR head, a TMR component will short-circuit with a hard magnet, and a current will not flow in a tunnel barrier layer. The problem that TMR rate of change is no longer obtained as a result, and a head output is no longer obtained occurs.
[0006] In order to avoid such a thing, U.S.P.5,729,410 are indicating the structure of insulating between TMR components with a hard magnet by the thin insulating layer. Moreover, this invention persons made T-like configuration the soft magnetism film which constitutes the flux probe section, extended the base of the flux probe section crosswise [truck], considered as the configuration where width of face is wider than the ferromagnetic tunnel effect film, and proposed the structure which forms a hard magnet or an antiferromagnetism layer in a part for the both ends (Japanese Patent Application No. No. 171869 [11 to]).
[0007] However, in connection with the densification of record, the magnetic record pattern recorded on media is reduced, and the area of the TMR component carried in the reproducing head must also be reduced in connection with it. For example, in order to make it adapted for the recording density of 40Gbspi, a TMR component must be reduced even to the size of 0.4x0.4 (micrometer2) extent. the size of the hard magnet which naturally impresses a bias field to a free layer, or the antiferromagnetism film -- small -- not becoming -- even if it does not obtain but applies the advanced technology mentioned above, it becomes difficult to impress sufficient bias field for a free layer.
[0008]
[Problem(s) to be Solved by the Invention] The technical problem of this invention is to offer a TMR component applicable to super-high density record, the thin film magnetic head, magnetic-head equipment, and a magnetic disk drive.
[0009] Another technical problem of this invention is offering the TMR component which can reinforce the bias field impressed to a free layer, the thin film magnetic head, magnetic-head equipment, and a magnetic disk drive.
[0010]
[Means for Solving the Problem] In order to solve such a technical problem, the TMR component concerning this

invention contains the ferromagnetic tunnel effect film, a magnetic-bias means, the 1st conductive layer, and the 2nd conductive layer.
[0011] Said ferromagnetic tunnel effect film has the structure whose tunnel barrier layer was pinched by the free layer and the pinned layer. Said magnetic-bias means impresses a bias field to said free layer.
[0012] said 1st conductive layer is arranged to the whole surface side of said ferromagnetic tunnel effect film -- having -- said ferromagnetic tunnel effect film -- electric -- flowing -- said 2nd conductive layer -- said ferromagnetic tunnel effect film -- on the other hand, it is arranged at a side, and flows electrically on said ferromagnetic tunnel effect film.
[0013] Either [at least] said 1st conductive layer or the 2nd conductive layer produces the field component of the same direction as said bias field according to the sense current which flows to self.
[0014] The TMR component concerning this invention has the ferromagnetic tunnel effect film which consists of multilayer structure of a free layer / tunnel barrier layer / pinned layer, and when a current is passed between the free layers and pinned layers whose tunnel barrier layer is pinched, the tunnel current which flows a tunnel barrier layer changes depending on whenever [angular relation / of the magnetization between a free layer and a pinned layer] (the TMR effectiveness). Although the direction of magnetization of a pinned layer is immobilization, the direction of magnetization of a free layer changes according to an external magnetic field. Therefore, an external magnetic field is detectable by detecting the current which flows for a TMR component, or its rate of change.
[0015] The TMR component concerning this invention includes a magnetic-bias means. A magnetic-bias means impresses a bias field to said free layer. Thereby, the Barkhausen noise in a free layer can be removed and the detecting signal of high quality can be obtained.
[0016] The TMR component concerning this invention contains the 1st conductive layer and the 2nd conductive layer. Said 1st conductive layer is arranged at the whole surface side of said ferromagnetic tunnel effect film, and it flows through it on said ferromagnetic tunnel effect film electrically, and it is also [film] used as an electrode layer and a magnetic-shielding layer. said 2nd conductive layer -- said ferromagnetic tunnel effect film -- on the other hand, it is arranged at a side, and flows electrically on said ferromagnetic tunnel effect film. Therefore, a sense current can be supplied to the ferromagnetic tunnel effect film 1 by the 1st and 2nd conductive layers.
[0017] Either [at least] said 1st conductive layer or the 2nd conductive layer produces the field component of the same direction as said bias field according to the sense current which flows to self. Therefore, the bias field which should be impressed to a free layer can be reinforced using the field which the sense current which flows to the 1st conductive layer or 2nd conductive layer makes.
[0018] For this reason, corresponding to high density record, the area of a TMR component is reduced and it is followed, and also when the size of the hard magnet which impresses a bias field to a free layer, or the antiferromagnetism film is reduced, it becomes possible to impress sufficient bias field for a free layer.
[0019] This invention is indicated again also about the electrode structure, the shielding structure over the ferromagnetic tunnel effect film, the thin film magnetic head that read the TMR component and was further used as a component, the magnetic-head equipment using this thin film magnetic head, and the magnetic disk drive for passing a current on the ferromagnetic tunnel effect film.
[0020]
[Embodiment of the Invention] The perspective view showing one example of the TMR component which drawing 1 requires for this invention, the partial expansion top view of the TMR component which showed drawing 2 to drawing 1 , the transverse-plane sectional view of the TMR component which showed drawing 3 to drawing 1 and drawing 2 , and drawing 4 are the sectional views which met four to 4 line of drawing 3 . These drawings are exaggeratingly illustrated so that he can understand the description part of this invention easily. The perimeter of the part shown by hatching is covered with the nonmagnetic insulating layer which becomes with the ceramics etc. in drawing 3 and drawing 4 .
[0021] The illustrated TMR component contains the ferromagnetic tunnel effect film 1, the magnetic-bias means 21, 23, and 24, the 1st conductive layer A, and the 2nd conductive layer B.
[0022] When drawing 3 and 4 are referred to, the ferromagnetic tunnel effect film 1 includes the tunnel barrier layer 11, the free layer 12, and a pinned layer 13. The tunnel barrier layer 11 of a pinned layer [the free layer 12 and] 13 is pinched.
[0023] The free layer 12 answers the external magnetic field which is magnetic information, and the sense of magnetization changes. Moreover, pinning of the pinned layer 13 is carried out so that the magnetization direction may turn to the fixed direction. Therefore, the laminating of the pinning layer 14 for carrying out pinning of the magnetization of a pinned layer 13 is usually carried out to a field opposite to the side which touches the tunnel barrier layer 11 of a pinned layer 13. In the illustration example, the laminating of the ferromagnetic tunnel effect film 1 is carried out to the order of the free layer 12, the tunnel barrier layer 11, and a pinned layer 13.
[0024] Although especially the thickness of the free layer 12 is not limited, it is good preferably to set [1-8nm / 1-6nm] it as the range of 1-4nm more preferably. If this thickness is set to less than 1nm, it will become difficult on a membrane formation technique to make width of face Lm of the cross direction of the bias field induction layer 21 into sufficient magnitude. Moreover, if this thickness exceeds 50nm, by dispersion in the property of the free layer 12 interior, distribution of electron spin polarizability will arise and un-arranging [that TMR rate of change will decrease as a result] will arise.
[0025] The quality of the material which constitutes the free layer 12 and a pinned layer 13 has the desirable high spin polarization ingredient with which high TMR rate of change is obtained, for example, Fe, Co, nickel, FeCo, NiFe,

CoZrNb, FeCoNi, etc. are used. These may be the layered products more than two-layer. As mentioned above, 1-8nm of thickness of the free layer 12 is preferably set to 1-4nm. If there is an inclination for an output to decline if thickness becomes thick too much and thickness becomes thin too much, magnetic properties will become unstable and un-arranging [that the noise at the time of head actuation increases] will arise. 1-10nm of thickness of a pinned layer 13 is preferably set to 2-5nm. If pinning of the magnetization by the pinning layer 14 will become weaker if thickness becomes thick too much, and thickness becomes thin too much, the inclination for TMR rate of change to decrease will arise.
[0026] Although the pinning layer 14 which carries out pinning of the magnetization of a pinned layer 13 will not be especially limited if the pinning function is achieved, an antiferromagnetism ingredient is usually used. Thickness is usually set to about 60-5nm.
[0027] The tunnel barrier layer 11 consists of A1203, NiO, GdO, MgO, Ta 2O5, MoO2 and TiO2, and WO2 grade. Although it is desirable that it is thin as much as possible for the reduction in resistance of a component, it is too thin not much, and leakage current will drop off and the thickness of the tunnel barrier layer 11 is not desirable, if a pinhole is generated. Generally, it may be about 0.5-2nm.
[0028] voice also with desirable also using the free layer 12 as the synthetic ferry magnet (synthetic ferrimagnet) illustrated by the three-layer layered product of for example, a NiFe layer (2nm in thickness) / Ru layer (0.7nm in thickness) / NiFe layer (2.5nm in thickness) in this invention — it is one [like]. In this case, the magnetization direction of an up-and-down NiFe layer and a NiFe layer turns into hard flow mutually, respectively. Since the thickness of the effectual free layer 12 can be thinly set up when a synthetic ferry magnet is used, magnetic field sensibility improves and there is a merit that an output becomes large. Moreover, such a synthetic ferry magnet is applicable also to a pinned layer 13.
[0029] In the above-mentioned ferromagnetic tunnel effect film 1, when the sense current IS is passed between the free layers 12 and pinned layers 13 whose tunnel barrier layer 11 is pinched, the tunnel current which flows the tunnel barrier layer 11 changes depending on whenever [angular relation / of the magnetization between the free layer 12 and a pinned layer 13]. Although the direction of magnetization of a pinned layer 13 is immobilization, the direction of magnetization of the free layer 12 changes according to an external magnetic field. Therefore, an external magnetic field is detectable by detecting the current which flows for a TMR component, or its rate of change.
[0030] The magnetic-bias means 21, 23, and 24 impress the bias field FX to the free layer 12, and have the bias field induction layer 21 and the bias grant means 23 and 24 in the example. The whole surface of the bias field induction layer 21 adheres to the ferromagnetic tunnel effect film 1. In the example, since the laminating of the ferromagnetic tunnel effect film 1 is carried out to the order of the free layer 12, the tunnel barrier layer 11, and a pinned layer 13, the free layer 12 will touch the whole surface of the bias field induction layer 21. As for the bias field induction layer 21, the width of face seen in the direction X of the bias field FX has become larger than the width of face of the ferromagnetic tunnel effect film 1.
[0031] The bias grant means 23 and 24 are seen in the direction X of the bias field FX, they separate spacing from the ferromagnetic tunnel effect film 1 to the both ends of the bias field induction layer 21, and they are equipped with them. The bias field FX generated by the bias grant means 23 and 24 is impressed to the free layer 12 through the bias field induction layer 21. The bias grant means 23 and 24 may consist of layered products of a high coercive force ingredient, an antiferromagnetism ingredient or an antiferromagnetism layer, and ferromagnetic layer much more at least.
[0032] The 1st conductive layer A is arranged at the whole surface side of the ferromagnetic tunnel effect film 1, and it flows through it electrically on the ferromagnetic tunnel effect film 1. the 2nd conductive layer B — the ferromagnetic tunnel effect film 1 — on the other hand, it is arranged at a side, and flows electrically on the ferromagnetic tunnel effect film 1. Therefore, the sense current IS can be supplied to the ferromagnetic tunnel effect film 1 by the 1st and 2nd conductive layers A and B.
[0033] In the case of an example, the laminating of the ferromagnetic tunnel effect film 1 is carried out to the order of the free layer 12, the tunnel barrier layer 11, and a pinned layer 13. Since it has structure which carried out the laminating of the pinning layer 14 on the pinned layer 13 and has the structure where the ferromagnetic tunnel effect film 1 which has this structure was made to adhere to the whole surface of the bias field induction layer 21 It becomes the structure where touch the bias field induction layer 21 to which the 1st conductive layer A touches the free layer 12, and the 2nd conductive layer B touches the pinning layer 14.
[0034] Either [at least] the 1st conductive layer A or the 2nd conductive layer B produces the field components FX1 or FX2 of the same direction as the bias field FX according to the sense current IS which flows to self. Therefore, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field components FX1 or FX2 which the sense current IS which flows to the 1st conductive layer A or the 2nd conductive layer B makes.
[0035] For this reason, corresponding to high density record, the area of a TMR component is reduced and it is followed, and also when the size of the hard magnet which impresses the bias field FX to the free layer 12, or the antiferromagnetism film is reduced, it becomes possible to impress sufficient bias field FX for the free layer 12.
[0036] In an illustration example, both 1st conductive layer A and 2nd conductive layer B produce the field components FX1 and FX2 of the same direction as the bias field FX according to the sense current IS which flows to self. Therefore, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field component FX1 which the sense current IS which flows to the 1st conductive layer A makes, and the field

component FXI which the sense current IS which flows to the 2nd conductive layer B makes.
[0037] Next, with reference to drawing 2 - drawing 4 , the generating mechanism of the current field components FX1 and FX2 is explained with concrete structure. Since it is the top view of the TMR component illustrated to drawing 1 as drawing 2 was mentioned above, each part illustrated by drawing 2 is expressed as flat-surface projection of a TMR component with three-dimensional structure. For example, it indicates all of reference marks X, Y, XY1, XY2, IX1, IX2, IY1, IY2, DX1, DX2, and alpha1 and alpha2 grade as flat-surface projection. When [all] mentioning the reference mark mentioned above by the following explanation, it is based on flat-surface projection.
[0038] If drawing 2 - drawing 4 are referred to, the 1st conductive layer A contains the 1st electrode / magnetic-shielding section 25 and 27, and the 1st lead polar zone 291. The 1st electrode / magnetic-shielding section 25 and 27 contain the electrode layer 25 and the magnetic-shielding layer 27. It has structure in which the whole surface of the electrode layer 25 carries out field contact at the bias field induction layer 21, and the other sides of the electrode layer 25 carry out field contact at the whole surface of the magnetic-shielding layer 27. Therefore, the 1st conductive layer A is made to serve a double purpose as an electrode layer and a magnetic-shielding layer.
[0039] The 2nd conductive layer B contains the 2nd electrode / magnetic-shielding section 26 and 28, and the 2nd lead polar zone 292. The 2nd electrode / magnetic-shielding section 26 and 28 have structure in which the whole surface of the electrode layer 26 carries out field contact at the whole surface of the pinning layer 14, and the other sides of the electrode layer 26 carry out field contact at the whole surface of the magnetic-shielding layer 28 including the electrode layer 26 and the magnetic-shielding layer 28. Therefore, the 2nd conductive layer B is made to serve a double purpose as an electrode layer and a magnetic-shielding layer.
[0040] The 1st lead polar zone 291 follows electrically the electrode layer 25 which constitutes the 1st electrode / magnetic-shielding section 25 and 27. The 1st lead polar zone 291 follows electrically a part of the 1st electrode / magnetic-shielding section 25 and 27 in the location where the sense current IS which flows in the 1st electrode / magnetic-shielding section 25 and 27 produces the field component FX1 of the same direction as the bias field FX.
[0041] More specifically the 1st lead polar zone 291 In the location which only distance DX 1 separated from the center line Y of the ferromagnetic tunnel effect film 1 which intersects perpendicularly with the direction X of the bias field FX in the direction X of the bias field FX It has the limited boundary length L1 shorter enough than the width of face of the 1st electrode / magnetic-shielding section 25 and 27 in a part of upper limb (setting to drawing) of the 1st electrode / magnetic-shielding section 25 and 27, and it is followed electrically. The 1st lead polar zone 291 may be formed as the same continuation film as the 1st electrode / magnetic-shielding section 25 and 27, and may be formed as different film. Distance DX 1 is the distance projected on the flat surface, as mentioned above.
[0042] The segment XY1 which connects the 1st central point P1 set up as the middle point of the boundary length L1 by this on the boundary line produced between the 1st electrode / magnetic-shielding section 25 and 27, and the 1st lead polar zone 291 and the central point P0 set as the ferromagnetic tunnel effect film 1 comes to cross by the plane angle alpha 1 to the segment lengthened in the direction X of the bias field FX. In this invention, a plane angle is the include angle projected on the flat surface, and the include angle in the 0-degree or more range of 90 degrees or less is said. That is, the plane angle alpha 1 is expressed in the include-angle range of 0 degree<=alpha1 <=90 degree.
[0043] In the above-mentioned configuration, when the sense current IS which flows in accordance with the segment (minimum distance) XY1 lengthened by the central point P0 of the ferromagnetic tunnel effect film 1 from the 1st central point P1 is assumed, it can decompose into the current component IX 1 of the direction X parallel to the bias field FX, and the current component IY1 of the direction Y perpendicular to the bias field FX, and the sense current IS can be considered. A current component IY1 produces the current field component FX1 of the same direction X as the bias field FX, as shown in drawing 3 . For this reason, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field component FXI.
[0044] In the case of an example, the 2nd lead polar zone 292 follows electrically the electrode layer 26 which constitutes the 2nd electrode / magnetic-shielding section 26 and 28. The 2nd lead polar zone 292 follows electrically a part of the 2nd electrode / magnetic-shielding section 26 and 28 in the location where the sense current IS which flows in the 2nd electrode / magnetic-shielding section 26 and 28 produces the field component FX2 of the same direction as the bias field FX.
[0045] More specifically the 2nd lead polar zone 292 In the location which only distance DX 2 separated from the center line Y of the ferromagnetic tunnel effect film 1 which intersects perpendicularly with the direction X of the bias field FX in the direction X of the bias field FX It has the limited boundary length L2 shorter enough than the width of face of the 2nd electrode / magnetic-shielding section 26 and 28 in a part of the 2nd electrode / magnetic-shielding section 26 and 28, and it is followed electrically. The 2nd lead polar zone 292 may be formed as the same continuation film as the 1st electrode / magnetic-shielding section 25 and 27, and may be formed as different film.
[0046] The segment XY2 which connects the 2nd central point P2 set up as the middle point of the boundary length L2 by this on the boundary line produced between the 2nd electrode / magnetic-shielding section 26 and 28, and the 2nd lead polar zone 292 and the central point P0 set as the ferromagnetic tunnel effect film 1 comes to cross by the plane angle alpha 2 to the segment lengthened in the direction X of the bias field FX.
[0047] In the above-mentioned configuration, when the sense current IS which flows in accordance with the segment (minimum distance) XY2 lengthened by the central point P0 of the ferromagnetic tunnel effect film 1 from the 2nd central point P2 is assumed, it can decompose into the current component IX 2 of the direction X parallel to the bias field FX, and the current component IY2 of the direction Y perpendicular to the bias field FX, and the sense

current IS can be considered. A current component IY2 produces the current field component FX2 of the same direction X as the bias field FX, as shown in drawing 3 . For this reason, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field component FXI. The plane angles alpha1 and alpha2 should just be 5 degrees or more.
[0048] The connecting location of the 1st [to the 1st electrode / magnetic-shielding section 25 and 27] lead polar zone 291 and the connecting location of the 2nd [to the 2nd electrode / magnetic-shielding section 26 and 28] lead polar zone 292 should just be locations which can produce the field components FX1 and FX2 of the same direction as the bias field F1 according to the sense current which flows to the 1st conductive layer A and the 2nd conductive layer B. In the example shown in drawing 1 - drawing 4 The 1st lead polar zone 291 and the 2nd lead polar zone 292 are divided into the both sides of a center line Y, and are arranged. According to this arrangement, in both 1st conductive layer A and 2nd conductive layer B, it is as having mentioned above that the current field components FX1 and FX2 of the same direction X as the bias field FX may be produced.
[0049] Since the TMR component illustrated by drawing 1 - drawing 4 impresses the bias field FX to the free layer 12 by the bias field induction layer 21 including the bias field induction layer 21, it can remove the Barkhausen noise in the free layer 12, and can obtain the detecting signal of high quality. Since the width of face seen in the direction X of the bias field FX is larger than the width of face of the ferromagnetic tunnel effect film 1, the bias field induction layer 21 can separate spacing from the ferromagnetic tunnel effect film 1 to a part for the both ends of the cross direction of the bias field induction layer 21, and can form the bias grant means 23 and 24 in it. For this reason, the electric short-circuit between the free layer 12-pinned layers 13 by the bias grant means 23 and 24 etc. is avoidable.
[0050] In order to make it not reduce TMR rate of change substantially, as for spacing between the ferromagnetic tunnel effect film 1 and the bias grant means 23 and 24, setting to the predetermined range is desirable. If the numeric value experimentally found out as a desirable mode is mentioned, as for said especially spacing, it will be desirable to consider as the range 0.02 micrometers or more of 0.3 micrometers or less, and the 0.02 more micrometer or more range of less than 0.15 micrometers 0.02 micrometers or more.
[0051] When the value of spacing is set to less than 0.02 micrometers, it is in the inclination for TMR rate of change to fall. If this G value becomes large too much and exceeds 0.3 micrometers on the other hand, the inclination which the effective width of recording track spreads and stops agreeing in the future demand to a raise in recording density will arise.
[0052] Moreover, in the gestalt of the above-mentioned operation, although the bias grant means 23 and 24 are arranged at the both-ends bottom of the free layer 12, they may be arranged to the down side, without being limited to this.
[0053] Furthermore, as for the bias field induction layer 21, an end constitutes the flux probe section 221. This flux probe section 221 is projected from the bias field induction layer 21. An external magnetic field is introduced into the bias field induction layer 21 from the flux probe section 221, and is further impressed to the free layer 12. Therefore, in application to the thin film magnetic head etc., the flux probe section 221 is located in the air bearing side ABS, and the ferromagnetic tunnel effect film 1 can be arranged in the location into which it withdrew from the air bearing side ABS. For this reason, it is avoidable that electric short-circuit occurs in the tunnel barrier layer 11 after the time of polish processing or polish processing.
[0054] The width of face of the flux probe section 221 is narrower than the width of face of the bias field induction layer 21, and since it is projected from the bias field induction layer 21, when the TMR component concerned is used as a reading component of the thin film magnetic head, it can set the regenerative-track width of face of a head as the minute value determined by the width of face of the flux probe section 221.
[0055] The width of face of the ferromagnetic tunnel effect film 1 is equal to the width of face of the flux probe section 221, or is set up greatly smaller than the width of face of the bias field induction layer 21. Width of face of about 0.5-4 micrometers and the flux probe section 221 is set to about 0.1-2 micrometers for the width of face of the bias field induction layer 21.
[0056] Furthermore, the 0.01-0.3 micrometers of the 0.01-0.2 micrometers of the amounts of protrusions of the flux probe section 221 are preferably set as 0.01-0.1 micrometers still more preferably. Although the more infinite one near 0 of this value is good, the danger of an electrostatic discharge arises or the electric short danger of the free layer 12 and pinned layer 13 in a polish process arises as it becomes small. Therefore, a lower limit is good to be referred to as about 0.01 micrometers. On the other hand, if the amount of protrusions exceeds 0.3 micrometers, an output will decline, or the crosswise bias field FX will become inadequate and a Barkhausen noise will arise.
[0057] Drawing 5 is the top view showing another arrangement of the 1st lead polar zone 291 and the 2nd lead polar zone 292. In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 2 . In this example, the 1st lead polar zone 291 is arranged in plane angle alpha1=90 degree and the location used as distance DX 1= 0. The location of the 2nd lead polar zone 292 is almost the same as the case of drawing 2 . Also in this case, in both 1st conductive layer A and 2nd conductive layer B, the current field components FX1 and FX2 of the same direction X as the bias field FX may be produced.
[0058] Drawing 6 is the top view showing still more nearly another arrangement of the 1st lead polar zone 291 and the 2nd lead polar zone 292. In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 2 . In this example, both the 1st lead polar zone 291 and the 2nd lead polar zone 292 are located in one side (it sets to drawing and is left-hand side [center line / Y]) of a center line Y. Also in this case, in both 1st conductive layer A and 2nd conductive layer B, the current field components FX1 and FX2

of the same direction X as the bias field FX may be produced.
[0059] Drawing 7 is the top view showing still more nearly another arrangement of the 1st lead polar zone 291 and the 2nd lead polar zone 292. In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 2 . In one side face which exists in the direction X of the bias field FX, succeeding the 1st conductive layer A, there is the 2nd lead polar zone 292 in the direction X of the bias field FX, and also the 1st lead polar zone 291 is following the 2nd conductive layer B in a side face in this example. The location of the 1st lead polar zone 291 and the 2nd lead polar zone 292 can be moved in the vertical direction in drawing along the side face of the 1st conductive layer A and the 2nd conductive layer B. also in this case, alpha1 and alpha — 2> 0 degree of current field components FX1 and FX2 of the same direction X as the bias field FX may be preferably produced in alpha 1 and the include-angle range of alpha2 >=5 degree.
[0060] It is clear that it is illustrated by drawing 1 - drawing 7 , and the combination of a thing, or these or an obvious combination exists variously about arrangement of the 1st lead polar zone 291 and the 2nd lead polar zone 292.
[0061] The perspective view showing another example of the TMR component which drawing 8 requires for this invention, the transverse-plane sectional view of the TMR component which showed drawing 9 to drawing 8 , and drawing 10 are the sectional views which met ten to 10 line of ** 9. In drawing, the same reference mark is attached about the same component as the component which appeared in the drawing explained previously. The illustrated TMR component contains the flux guide layer 22. The flux guide layer 22 is magnetically combined with the free layer 12, and the end constitutes the flux probe section 221. This flux probe section 221 is projected from the bias field induction layer 21. An external magnetic field is introduced from the flux probe section 221, passes along the flux guide layer 22, and is impressed to the free layer 12. Therefore, in application to the thin film magnetic head etc., the flux probe section 221 is located in the air bearing side ABS, and the ferromagnetic tunnel effect film 1 can be arranged in the location into which it withdrew from the air bearing side ABS. For this reason, it is avoidable that electric short-circuit occurs in the tunnel barrier layer 11 after the time of polish processing or polish processing.
[0062] The width of face of the flux probe section 221 is narrower than the width of face of the bias field induction layer 21, and since it is projected from the bias field induction layer 21, when the TMR component concerned is used as a reading component of the thin film magnetic head, it can set the regenerative-track width of face of a head as the minute value determined by the width of face of the flux probe section 221.
[0063] And since the flux guide layer 22 is layer with the another bias field induction layer 21, it can form the flux guide layer 22 according to membrane formation process that the bias field induction layer 21 is another.
[0064] The flux guide layer 22 intersects the direction X of the bias field FX of the bias field induction layer 21, and the end constitutes the flux probe section 221. Therefore, also when the flux guide layer 22 produces a radius of circle in the edge, the radius-of-circle part can be removed and the interstitial segment by which the width-of-face dimension was stabilized can be used as the flux probe section 221. For this reason, the TMR component which has the highly precise reading width of recording track can be obtained.
[0065] Also in the example shown in drawing 8 - drawing 10 , the 1st lead polar zone 291 follows electrically a part of the 1st electrode / magnetic-shielding section 25 and 27 in the location where the sense current IS which flows in the 1st electrode / magnetic-shielding section 25 and 27 produces the field component FX1 of the same direction as the bias field FX. The 2nd lead polar zone 292 follows electrically the electrode layer 26 which constitutes the 2nd electrode / magnetic-shielding section 26 and 28. The 2nd lead polar zone 292 follows electrically a part of the 2nd electrode / magnetic-shielding section 26 and 28 in the location where the sense current IS which flows in the 2nd electrode / magnetic-shielding section 26 and 28 produces the field component FX2 of the same direction as the bias field FX. Thereby, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field components FXI and FX2 (refer to drawing 9).
[0066] The perspective view showing another example of the TMR component which drawing 11 requires for this invention, the expanded sectional view of the TMR component which showed drawing 12 to drawing 11 , and drawing 13 are the sectional views which met 13 to 13 line of drawing 12 . In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 1 -3. In this example, the laminating of the ferromagnetic tunnel effect film 1 is carried out to the order of the free layer 12, the tunnel barrier layer 11, and a pinned layer 13. The flux guide layer 22 is formed in the free layer 12 and this body. Although the flux guide layers 22 are the free layer 12 and this body, the bias field induction layer 21 is another layer, and the laminating of them is carried out on the bias field induction layer 21.
[0067] The 1st lead polar zone 291 follows electrically a part of the 1st electrode / magnetic-shielding section 25 and 27 in the location where the sense current IS which flows in the 1st electrode / magnetic-shielding section 25 and 27 produces the field component FX1 of the same direction as the bias field FX.
[0068] The 2nd lead polar zone 292 follows electrically the electrode layer 26 which constitutes the 2nd electrode / magnetic-shielding section 26 and 28. The 2nd lead polar zone 292 follows electrically a part of the 2nd electrode / magnetic-shielding section 26 and 28 in the location where the sense current IS which flows in the 2nd electrode / magnetic-shielding section 26 and 28 produces the field component FX2 of the same direction as the bias field FX. Thereby, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field components FXI and FX2 (refer to drawing 12).
[0069] The transverse-plane sectional view showing another example of the TMR component which drawing 14 requires for this invention, and drawing 15 are the sectional views which met 15 to 15 line of drawing 14 . In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 1 -3.

In this example, the ferromagnetic tunnel effect film 1 has the structure which carried out the laminating to the order of a pinned layer 13, the tunnel barrier layer 11, and the free layer 12. The bias field induction layer 21 adjoins the free layer 12, and the laminating of the flux guide layer 22 is carried out on the bias field induction layer 21. The flux guide layer 22 is another layer in the bias field induction layer 21.

[0070] The 1st lead polar zone 291 follows electrically a part of the 1st electrode / magnetic-shielding section 25 and 27 in the location where the sense current IS which flows in the 1st electrode / magnetic-shielding section 25 and 27 produces the field component FX1 of the same direction as the bias field FX.

[0071] The 2nd lead polar zone 292 follows electrically the electrode layer 26 which constitutes the 2nd electrode / magnetic-shielding section 26 and 28. The 2nd lead polar zone 292 follows electrically a part of the 2nd electrode / magnetic-shielding section 26 and 28 in the location where the sense current IS which flows in the 2nd electrode / magnetic-shielding section 26 and 28 produces the field component FX2 of the same direction as the bias field FX. Thereby, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field components FXI and FX2 (refer to drawing 14).

[0072] The transverse-plane sectional view showing another example of the TMR component which drawing 16 requires for this invention, and drawing 17 are the sectional views which met 17 to 17 line of drawing 16 . In drawing, the same reference mark is attached about the same component as the component which appeared in drawing 1 -3. In this example, the ferromagnetic tunnel effect film 1 has the structure which carried out the laminating to the order of a pinned layer 13, the tunnel barrier layer 11, and the free layer 12. The bias field induction layer 21 is formed in the free layer 12 and this body. The flux guide layer 22 is another layer in the bias field induction layer 21, and the laminating is carried out on the bias field induction layer 21.

[0073] The 1st lead polar zone 291 follows electrically a part of the 1st electrode / magnetic-shielding section 25 and 27 in the location where the sense current IS which flows in the 1st electrode / magnetic-shielding section 25 and 27 produces the field component FX1 of the same direction as the bias field FX.

[0074] The 2nd lead polar zone 292 follows electrically the electrode layer 26 which constitutes the 2nd electrode / magnetic-shielding section 26 and 28. The 2nd lead polar zone 292 follows electrically a part of the 2nd electrode / magnetic-shielding section 26 and 28 in the location where the sense current IS which flows in the 2nd electrode / magnetic-shielding section 26 and 28 produces the field component FX2 of the same direction as the bias field FX. Thereby, the bias field FX which should be impressed to the free layer 12 can be reinforced using the field components FXI and FX2 (refer to drawing 16).

[0075] Also in the example shown in drawing 8 - drawing 17 , the 1st and 2nd lead polar zone 291 and 292 of the ability of the location explained with reference to drawing 5 - drawing 7 to be taken is obvious.

[0076] the TMR component which drawing 18 mentioned above — reading — as a component — using — an induction type — electromagnetism — the perspective view of the thin film magnetic head for the record within a field which wrote in the sensing element and was used as a component, and drawing 19 show the expanded sectional view of the thin film magnetic head shown in drawing 18 . The thin film magnetic head of illustration has the write-in component 5 which consisted of TMR components which start this invention on a slider 4 and which reads and becomes by the component 6 and the induction type MAG sensing element. An arrow head A1 shows the medium transit direction. In drawing, the dimension is exaggerated partially and differs from a dressed size.

[0077] A slider 4 has rails 41 and 42 in a medium opposed face side, and the front face of a rail is used as ABS 43 and 44. Rails 41 and 42 are not restricted to two. It may become the flat surface which may have 1-3 rails and does not have a rail. Moreover, various geometry may be given to a medium opposed face for a surfacing property improvement etc. Even if it is the slider 4 of which type, application of this invention is possible. Moreover, since a slider 4 is equipped with protective coats, such as DLC which has about 8-10nm thickness, on the surface of a rail, in such a case, the front face of a protective coat serves as ABS 43 and 44. A slider 4 is the ceramic structure which formed aluminum 2O3 and the inorganic insulator layer 420 of SiO2 grade in the front face of the base 410 which becomes by aluminum2O3-TiC etc.

[0078] Both one side [of rails 41 and 42] or trailing . edge TR side is equipped with the write-in component 5 and the reading component 6. a slider 4 is equipped with the write-in component 5 and the reading component 6 — having — electromagnetism — the edge for conversion is located in ABS 43 and 44 and the location which approached. The ejection electrodes 47 and 48 which were connected to the write-in component 5 and which took out and were connected to electrodes 45 and 46 and the reading component 6 are formed in the slider side face in the trailing . edge TR side, respectively.

[0079] The write-in component 5 has the gap film 54, an insulator layer 55, a protective coat 56, etc. which become with the 1st magnetic film 51 which serves as the 2nd [to the reading component 6] shielding film, the 2nd magnetic film 52, the coil film 53, an alumina, etc. Independently of the 1st magnetic film 51, you may have the 2nd shielding film.

[0080] The end sections (point) 510 and 520 of the 1st magnetic film 51 and the 2nd magnetic film 52 are the pole section which separates the gap film 54 of minute thickness and counters, and write in in the pole section. The 1st and 2nd magnetic films 51 and 52 may be monolayers, and may be double layer membrane structures. Double layer membrane-ization of the 1st and 2nd magnetic films 51 and 52 may be performed for the purpose of for example, a property improvement. Various amelioration and a proposal are made also about the structure of the pole section from viewpoints, such as improvement in narrow-izing of the width of recording track, and record capacity. In this invention, any pole structure proposed until now is employable. The gap film 54 is constituted by inorganic insulator layers, such as non-magnetic metal film or an alumina.

[0081] The 2nd magnetic film 52 inclines and starts to a pole section side at a certain include angle to a field parallel to the field of the gap film 54. Further, the 2nd magnetic film 52 maintains an inner gap between the 1st magnetic film 51, is prolonged behind ABS 43 and 44, and is combined with the 2nd magnetic film 52 in back. Thereby, the thin film magnetic circuit involving the 1st magnetic film 51, 2nd magnetic film 52, and gap film 54 is completed.
[0082] The coil film 53 is inserted between the 1st and 2nd magnetic films 51 and 52, and turns around the surroundings of a back bond part to a curled form. It has flowed through the both ends of the coil film 53 in the ejection electrodes 45 and 46 (refer to drawing 37). The number of turns and number of layers of the coil film 53 are arbitrary. The coil film 53 is laid under the interior of an insulator layer 55.
[0083] The interior of the inner gap between the 1st and 2nd magnetic films 51 and 52 is filled up with the insulator layer 55. The front face of an insulator layer 55 is equipped with the 2nd magnetic film 52. An insulator layer 55 consists of organic insulation resin film or ceramic film. The example of representation of the ceramic film is 2Oaluminum3 film or SiO2 film. If the ceramic film constitutes an insulator layer 55, since the thermal expansion of an insulator layer 55 will become small as compared with the case where an organic compound insulator is used, a result good for reducing the amount of the maximum protrusions is obtained.
[0084] In the protective coat 56, the protective coat 56 has covered the write-in whole component 5. By this, the write-in whole component 5 will be protected by the protective coat 56. The protective coat 56 consists of inorganic insulating materials of aluminum 2O3 or SiO2 grade.
[0085] The reading component 6 consists of TMR components concerning this invention. This reading component 6 is arranged inside the insulator layer 63 between the 1st shielding film 61 and the 2nd shielding film 63. The insulator layer 63 is constituted by the alumina etc. The reading component 6 is connected to the ejection electrodes 47 and 48 which flow on the 1st shielding film 61 and the 2nd shielding film 62 (refer to drawing 18).
[0086] Drawing 20 is the expanded sectional view of the thin film magnetic head for vertical recording. In the illustrated thin film magnetic head for vertical recording, the 2nd magnetic film 52 contains the main pole 525 and the auxiliary magnetic pole 526. The main pole 525 constitutes the perpendicular write-in pole section, and the auxiliary magnetic pole 526 combines magnetically the main pole 525 and the 1st magnetic film 51. The 1st magnetic film 51 constitutes the return magnetic path of the magnetic flux produced from the main pole 525. The coil film 53 is wound around the surroundings of the main pole 525 and the auxiliary magnetic pole 526. Since it is substantially the same, explanation is abbreviated to the thin film magnetic head for the record within a field which showed other structures to drawing 18 . Since the description of magnetic recording using the thin film magnetic head for vertical recording magnetizes the magnetic-recording film of a magnetic disk in the direction which becomes perpendicular to a film surface and performs magnetic recording, it is that very high recording density is realizable.
[0087] The front view showing some magnetic-head equipments which drawing 21 requires for this invention, and drawing 22 are the bottom views of the magnetic-head equipment shown in drawing 41. Magnetic-head equipment contains the thin film magnetic head 8 and the head means for supporting 7. The thin film magnetic head 8 is the thin film magnetic head concerning this invention explained with reference to drawing 18 - drawing 20 .
[0088] The head means for supporting 7 have structure which attached the flexible body 71 which similarly becomes with a metallic thin plate in the free end in the end of the longitudinal direction of the base material 73 which becomes with a metallic thin plate, and attached the thin film magnetic head 8 in the inferior surface of tongue of this flexible body 71.
[0089] A flexible body 71 has two outside frame parts 75 and 76 which carry out abbreviation parallel with the longitudinal direction axis of a base material 73, and are extended, the transversal frame 74 which connects the outside frame parts 75 and 76 in the edge distant from the base material 73, and the ligula 72 which has been prolonged so that abbreviation parallel may be carried out from the abbreviation center section of the transversal frame 74 at the outside frame parts 75 and 76, and used the tip as the free end.
[0090] The projection 77 for loads of the shape of a semi-sphere of a ligula 72 which upheaved from the base material 73 in the center section mostly is formed. The load force is told from the free end of a base material 73 by this projection 77 for loads to a ligula 72.
[0091] The thin film magnetic head 8 is attached in the inferior surface of tongue of a ligula 72 with means, such as adhesion. The thin film magnetic head 8 is attached in the ligula 72 so that an airstream appearance side edge side may become in the direction of a transversal frame 74. The head means for supporting 7 applicable to this invention are not restricted to the above-mentioned example.
[0092] Drawing 23 is drawing showing typically the configuration of the magnetic disk drive concerning this invention. The illustrated magnetic disk drive contains magnetic-head equipment 9 and a magnetic disk 10. Magnetic-head equipment 9 is illustrated to drawing 21 and 22. The end of the head means for supporting 7 is supported by the pointing device 11, and magnetic-head equipment 9 is driven. The thin film magnetic head 8 of magnetic-head equipment is supported by the head means for supporting 7, and it is arranged so that it may counter with the magnetic-recording side of a magnetic disk 10.
[0093] If the rotation drive of the magnetic disk 10 is carried out in the direction of an arrow head A1 by the driving gear which is not illustrated, the thin film magnetic head 8 will surface from the field of a magnetic disk 10 by the minute flying height. By the positioning device 11 which carries out the rotation drive of the head means for supporting 7, the thin film magnetic head 8 which the magnetic disk drive illustrated by drawing 23 is a drive method called a rotary . actuator method, and was attached in the point of the head means for supporting 7 is driven in the directions b1 or b2 of a path of a magnetic disk 10, and is positioned in the predetermined truck location on a magnetic disk 10. And magnetic recording by the write-in component 5 and reading actuation by the reading

component 6 which has a TMR component are performed on a predetermined truck.
[0094] As mentioned above, although the contents of this invention were concretely explained with reference to the desirable example, it is obvious that various deformation modes can be taken based on the fundamental technical thought of this invention and instruction if it is this contractor.
[0095]
[Effect of the Invention] According to this invention, the following effectiveness can be acquired as stated above.
(a) A TMR component applicable to super-high density record, the thin film magnetic head, magnetic-head equipment, and a magnetic disk drive can be offered.
(b) The TMR component which can reinforce the bias field impressed to a free layer, the thin film magnetic head, magnetic-head equipment, and a magnetic disk drive can be offered.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing one example of the TMR component concerning this invention.
[Drawing 2] It is the partial expansion top view of the TMR component shown in drawing 1 .
[Drawing 3] It is the transverse-plane sectional view of the TMR component shown in drawing 1 and drawing 2 .
[Drawing 4] It is the sectional view which met four to 4 line of drawing 3 .
[Drawing 5] It is the top view showing another arrangement of the 1st lead polar zone in the TMR component concerning this invention, and the 2nd lead polar zone.
[Drawing 6] It is the top view showing still more nearly another arrangement of the 1st lead polar zone in the TMR component concerning this invention, and the 2nd lead polar zone.
[Drawing 7] It is the top view showing still more nearly another arrangement of the 1st lead polar zone in the TMR component concerning this invention, and the 2nd lead polar zone.
[Drawing 8] It is the perspective view showing another example of the TMR component concerning this invention.
[Drawing 9] It is the partial expansion top view of the TMR component shown in drawing 8 .
[Drawing 10] It is the sectional view which met ten to 10 line of drawing 9 .
[Drawing 11] It is the perspective view showing still more nearly another example of the TMR component concerning this invention.
[Drawing 12] It is the transverse-plane sectional view of the TMR component shown in drawing 11 .
[Drawing 13] It is the sectional view which met 13 to 13 line of drawing 12 .
[Drawing 14] It is the transverse-plane sectional view showing still more nearly another example of the TMR component concerning this invention.
[Drawing 15] It is the sectional view which met 13 to 13 line of drawing 14 .
[Drawing 16] It is the transverse-plane sectional view showing still more nearly another example of the TMR component concerning this invention.
[Drawing 17] It is the sectional view which met 17 to 17 line of drawing 16 .
[Drawing 18] the TMR component concerning this invention — reading — as a component — using — an induction type — electromagnetism — perspective view **** of the thin film magnetic head for the record within a field which wrote in the sensing element and was used as a component.
[Drawing 19] It is the expanded sectional view of the thin film magnetic head shown in drawing 18 .
[Drawing 20] It is the expanded sectional view of the thin film magnetic head for vertical recording which read the TMR component concerning this invention and was used as a component.
[Drawing 21] It is the front view showing some magnetic-head equipments concerning this invention.
[Drawing 22] It is the front view showing some magnetic-head equipments concerning this invention.
[Drawing 23] It is drawing showing typically the configuration of the magnetic disk drive concerning this invention.
[Description of Notations]
1 Ferromagnetic Tunnel Effect Film
11 Tunnel Barrier Layer
12 Free Layer
13 Pinned Layer
25 27 The 1st electrode / magnetic-shielding section
26 28 The 2nd electrode / magnetic-shielding section
291 1st Lead Polar Zone
292 2nd Lead Polar Zone
A The 1st conductive layer
B The 2nd conductive layer

[Translation done.]